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ABSTRACT

This paper builds upon the poetics of scientific discourse which provide extraordinary insights into the workings of the scientific imagination and into the ways it is both colonized and liberated by the medium of social and ideological transfer--metaphor. The paper examines what constructivism is teaching us about the role metaphor plays in science; reviews some recent constructivist analyses which display archetypal metaphors in selected scientific texts; undertakes a brief case study of the gender-based folklore and mythopoetics of some programmatic texts produced by the artificial intelligence movement; and identifies the challenges mythopoetic analysis of scientific texts pose for the development of more satisfactory theories of knowledge. The paper is in four sections: (1) Metaphor: Wing of Knowledge and Agent of Ideological Transfer; (2) The Phallus in the Paradigm: Feminist Dis-coveries of the Faded Mythologies of Scientific Metaphors (sexual/copulative images, and reproductive images); (3) Making Minds: Sexual and Reproductive Metaphors in the Discourse of Artificial Intelligence Scientists (images of creativity, immortality, and progress, and reproduction as destruction); and (4) Coitus Interruptus: Feminist Alternatives. Ninety-nine notes are included. (SR)

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Mind Machines, Myth, Metaphor, and Scientific Imagination

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Social constructivist models of scientific activity have assumed growing importance in the sociology and philosophy of Western science during the past decade. Indeed some critics maintain social constructivism is becoming the dominant paradigm for studies in these fields. (1)

While positivist, empiricist, realist, and instrumentalist models of science conceive of the scientist as an impartial observer faithfully deciphering nature's secrets and recording them in a univocal language that reveals (dis-covers and corresponds to) her essential truths; constructivism problematizes the processes of observation, discovery, description, and interpretation. It rejects the correspondence theory of truth and the formalist, reductionist, and essentialist assumptions upon which it rests. Ultimately, constructivism even renders conceptions of nature articulated by older models of scientific reasoning suspect.

Constructivism turns the critical eye of scientific inquiry on the scientific enterprise itself. (2) It conceives of science as a form of communication: as an artifact of language, culture, and history which is responsive to the interests, perspectives, priorities, and values of the communities that produce it. Constructivism recognizes that in the process of producing coherent accounts of the workings of the world, scientists also produce texts. It treats these texts as amenable to semiotic and socio-rhetorical inquiries. Constructivists maintain that development of a poetic and pedagogy for analyzing scientific discourse is an essential prerequisite to articulation of an adequate theory (or theories) of knowledge. (3) This conclusion follows necessarily from embrace of what David Bloor has called the "strong program" in the sociology of knowledge: a research program committed to using the perspective of the sociology of knowledge to study all forms of knowledge including mathematical and logical thinking. (4)

This approach is faithful to the tenets of scientific naturalism which guide other forms of scientific inquiry; nevertheless it has met significant resistance. The resistance has three major sources. First, identifying gaps or biases in scientific models is a form of nay-saying; it implies that the finest work produced by some of our finest minds is not as fine as we've been lead to believe. It also suggests that scientific rationality is not rational in all of the ways older theories of knowledge claimed. In short, it steps on toes. Resistance of this kind is understandable but it is not justified by the warrant of science which claims epistemological privilege on the grounds that it is always open to revision.

The second form of resistance maintains that analysis of

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the genesis of scientific ideas is irrelevant to the project of science. It charges constructivism with undermining the authority of scientific truth without adding anything of significance to the body of scientific knowledge. This criticism denies the knowledge produced by the social sciences "scientific" status; it also misreads the motives of constructivist inquiries. (5) Textual analysis of scientific discourse does not challenge the utility or internal validity of systems of scientific explanation. Making and testing the laws of physics is the work of physicists not rhetoricians. However rhetorical analysis can enrich our understanding of physics by restoring the human voice to modes of scientific assertion; it can also identify the hidden socio-political agendas of science, and decode the extra-territorial power-claims of scientists (scientism).

The third form of resistance reinforces the other two, and is even more intractable because it has its origins in the founding struggles of science. In liberating science from religion, the fathers of the Enlightenment endowed science with the kind of authority that had previously been ascribed to theology. That is, the Enlightenment treated the founding assumptions of science as "sacred" and placed them beyond critical interrogation. (6) As a result, it planted the roots of scientific thinking which claims to be "the very archetype of antimyth" firmly in the soil of myth-making. (7)

Analysis of the mythopoetics of scientific discourse provides fertile grounds for inquiry for the following reasons: (A) the presence of mythological elements in scientific thinking is a paradox that calls into question established conceptions of rationality, objectivity, and scientific progress; (B) mythological elements encoded in scientific discourse provide access to what Sandra Harding has called the "social fingerprints" of science, the relationship between the social and cultural contexts of scientific creators and the kinds of cognitive structures they favor; (C) the presence of some social fingerprints on scientific models and the systematic absence of others raises questions about science's claims to cognitive purity, universality, and privileged epistemological status; (D) unexamined myths have a "subterranean potency" (Keller) which can channel our thinking into certain conceptual categories while rendering others inconceivable; (E) unexamined mythological elements in scientific discourse can reduce epistemology to "implicit propaganda"; when this happens, theories of knowledge reflect and reify social ideologies, they lack autonomy and "rise and fall as their corresponding ideology rises and declines" (Bloor); (F) the apparent intractability of mythic elements in processes of scientific creativity indicates that scientific ways of knowing do not transcend intuition or conform to the requirements of univocal discourse; consequently analysis of the poetics of scientific texts may provide portals for (i) constructing more accurate/eloquent theories of knowledge and/or (ii) mapping the limits of knowledge.

Studies of the poetics of scientific discourse do not exhaust the productivity of the constructivist research program, nevertheless they provide extraordinary insights into the workings of the scientific imagination and into the ways it is both colonized and

liberated by the medium of social and ideological transfer, metaphor. (9) This paper builds upon the insights provided by these studies. It has four objectives: (A) to examine what constructivism is teaching us about the role metaphor plays in science; (B) to review some recent constructivist analyses which display archetypal metaphors in selected scientific texts; (C) to undertake a brief case-study of the gender-based folklore and mythopoetics of some programmatic texts produced by the artificial intelligence movement; (D) to identify the challenges mythopoetic analysis of scientific texts pose for the development of more satisfactory theories of knowledge.

I: Metaphor: Wing of Knowledge and Agent of Ideological Transfer.

Susanne Langer described the power to name as "the vastest generative idea that ever was conceived". (10) Science names nature. It translates the unknown into the known by creating theories and models which both construct and contain nature. (11) These theories and models are then subjected to rigorous tests to determine if they are reliable guides for organizing accounts of natural events.

The language of the founding fathers of modern science was metaphorically rich; yet, they advocated purging all metaphoric elements and rhetorical embellishments from the language of science. (12) Traditional philosophies of science embraced this quest for linguistic puritanism; however, language has resisted all attempts to scrub away its beauty marks. As a result, metaphors continue to act as anchors for scientific discourse. They provide the unifying vision --the design-- which permits scientists to order and arrange their observations into coherent and, for a time, compelling patterns. Constructivism conceives of metaphors as portals of truth; radical constructivism embraces Nietzsche's definition of "truth" as "a mobile army of metaphors". (13)

Science uses metaphors to conquer, map, colonize and name the unknown. Recent work in philosophy and linguistics indicates that metaphoric thinking is ubiquitous. (14) Indeed, George Lakoff maintains that it "is this imaginative capacity that allows for 'abstract' thought and takes the mind beyond what we can see and feel". (15) Metaphors empower scientific vision; they provide the scaffolding for arguments, color the language of assertion, put the poetry in the paradigms, and guide inquiry. In short, they make science possible. And contrary to the tenets of older theories of knowledge, the processes by which they achieve this empowerment are rational because, as Mary Hesse points out, "rationality consists just in the continuous adaptation of our language to our continually expanding world, and metaphor is one of the chief means by which this is accomplished". (16)

Metaphor permits us to expand the horizons of our knowledge by allowing us to experience and understand one kind of thing in terms of another. (17) The kinds of <u>things</u> we use to achieve understanding of other <u>things</u> do not represent promiscuous couplings; they do not simply involve slips of the tongue. These <u>things</u> embody, display, preserve and police the "faded mythology" (Schelling) that creates order and makes communication possible. They lay the foundations for construction of the cognitive

categories which permit humans to perceive, organize, process and remember perceptions, images, and information.

In Women, Fire, and Dangerous Things, George Lakoff maintains that thought is "embodied": "it grows out of our bodily experience and makes sense in terms of it". (18) Our imaginative capacity --our metaphors, metonymies, and images-- are extensions of our system of perception, bodily movement, and our experience of our physical and social character. In sum, the material things we invoke to conceive of non-material "things" or apparentlyly disembodied concepts or ideas, are and must be anthropocentric. These "things" are apprehended by the human eye, formed by the human tongue, tuned to the human ear, conceived and comprehended by the human brain.

The kinds (categories) of things that members of a speech community can use to dramatize their ideas are therefore biologically and culturally patterned, purposive, and socially significant. As a result, word and world set limits on what things scientists can fruitfully use to comprehend other things: "no model even gets off the ground unless some antecedent similarity or analogy is discerned between it and the explanandum". (19)

Although metaphoric thinking is neither irrational nor quixotic, it is not benign. Scientific metaphors do not just name the world or facilitate adaptation to it, they change it. They achieve this word magic by changing the way we interact with nature. Thus, for example, if, as in many traditional cultures, nature is considered to be a mother, alive and sensitive, then it may be considered a violation of human ethical standards to carry out destructive acts against her. (20) Conversely, if nature is considered to be a machine, as in the Newtonian "world machine", it becomes more like a machine; and actual machines --artifacts of human art, craft, and commerce-- are stripped down to their essential properties of mass and motion. (21) In sum, how we name nature affects the way we treat her (or it), how we organize our adaptive efforts, how we use resources, how we intervene in and transform natural processes, and how we relate to other species, races, and genders.

Textual analysis indicates that metaphors involving images of sexual relations and reproduction are both common and deeply embedded in the discourse of Western science and culture. (22) What Sandra Harding has called the "totemism of gender" provides the grounds for the categories of Indo-European languages and organizes them into polarities which emphasize difference. (23) Consequently sexual imagery is frequently invoked to describe the mediation between subject and object, man and nature. The mythos within these metaphors sees knowledge as a form of consummation and coition as a form of knowledge; both sex and knowledge are viewed as driven by desire and passionate pursuit. The English language displays this mythos in verbs like conceive and know which have both cognitive and carnal referents. (24)

Western metaphoric conventions conceive of ideas (or meanings) as objects, e.g. the speaker puts ideas into words. Discourses (and cultures), in turn, achieve coherence and

integration by conventionalizing these metaphors and burying their roots. As Richard Rorty puts it, "Old metaphors are constantly dying off into literalness, and then serving as a platform and foil for new metaphors". (25) In the Western world, this process of reification makes illusions of 'objectivity' possible.

Within Western languages, both organic and inorganic imagery are invoked to convey the materiality of ideas: ideas are conceived, born, and nurtured; the best ones are seminal; they penetrate, they are sharp, have points and cutting edges, they cast light, illuminate or lead mortals to the light (God/immortality). Rationality is transparently conceived within the totemic of polarized categories. An argument is either rational or irrational; if it fails to conform to this binary rule, it is tagged "non-rational" and declared outside of the parameters of formal discourse. Arguments are good or bad, logical or illogical, relevant or irrelevent. Rationality is also conceived as lineal and hierarchical: a thinker escapes from the depths of irrationality, and climbs the ladder or scales the mountain of abstraction. In discourse on rationality, the roots of the totemic are buried in shallow ground; sometimes they are directly exposed as when rationality and masculinity are conflated and femininity and irrationality are equated.

Ideas may be conceived, but arguments are crafted. Argumentation (formal/scientific reasoning) is represented by four dialectically related metaphoric conventions: it is conceived as building (construction), war (destruction), journey (movement) and containment (rest). (26) Arguments are constructed, they have foundations, frameworks, and structures, they need support, they can be buttressed, sometimes they collapse. Positions are attacked, defended, captured, secured, destroyed or demolished. Arguments are advanced, they progress, they have goals. Strong arguments are re-searched, they are developed step-by-step, they cover a lot of ground, they permit us to arrive at conclusions if we don't stray from the path and go in the wrong direction. Finally, the good argument (like the good wife of androcentric discourse) has form, content, substance, and consistency; it is orderly and methodical. Bad arguments, however, like sexual or barren women contain faults, have holes in them, won't hold water, are empty.

Deconstructions of gendered structures and connotations of metaphors gloss over the ambiguities and dialectical twists that make good metaphors resilient enough to adapt our language to "our continually expanding world". Nevertheless when the totemic template is applied to the "faded mythology" conserved in the above metaphors, thinkers/scientists are conceived as progenitors, warriors, architects, builders, hunters, discoverers, explorers, missionaries, and alchemists. (27) In short, they are men, and the ideology the gender totemic transfers is patriarchy.

II. The Phallus in the Paradigm: Feminist Dis-coveries of the Faded Mythologies of Scientific Metaphors.

The faded mythology preserved in these androcentric metaphors suggest that thinking/reasoning is something men have traditionally done in groups (or speech communities) outside of the enclosures of home, hearth, and female nurturing. They conceive of thinking as a form of male-bonding.

According to Lionel Tiger, no friend of feminism, rites of male-bonding are "the male equivalent of child reproduction, which is related to work, defense, politics, and perhaps even the violent mastery and destruction of others". (28) Brian Easlea makes a similar point when he asserts,

> Men in prescientific societies, it may be generally argued, attempt to affirm masculine and, for them therefore, dominant status through secret exclusively male rituals. Quite often these rituals have a very direct 'pregnant phallus' aspect to them, the male participants thereby demonstrating that through their special phallic powers they, like women, are able to give birth. (29)

Deconstructions of the mythopoetics of scientific texts indicate that the primitive metaphor of the pregnant phallus also provides the platform and foil for articulation of images of creativity, immortality, and progress in scientific texts. The powers of the pregnant phallus are displayed in two ways: through sexual/copulative images and reproductive images.

A. Sexual/Copulative Images.

The discipline of modern science modeled itself after the routinization of time and work of a medieval male sanctuary, the monastery. Early articulations of scientific methodology embodied the medieval conception of a rational universe ordered by God. (30) Francis Bacon saw God as man's partner in the pursuit of knowledge. (31) Bacon conceived of nature as a woman to be conquered by man for God (as opposed to witches who were created/conquered by sexual liasons with the devil).

Articulation of the method and mythos of modern science, it should be remembered, took place during "a burst of misogyny without parallel in Western history". (32) As a lawyer Bacon was conversant in the issues surrounding the inquisition of witches. Carolyn Merchant demonstrates that this social knowledge "permeated his descriptions of nature and his metaphorical style," and was "instrumental in his transformation of the earth as nurturing mother and womb of life into a source of secrets to be extracted for economic advance". (33) Bacon accepted the conventional wisdom of the day which maintained that witches were consorts of the devil, and that every woman was potentially a witch because, like Eve, she possessed insatiable carnal appetites. The Baconians emphasized the

masculine character of science in an attempt to (a) purge male fears of the diabolical powers of witches, and (b) place the promises and potions of scientists beyond the inquisitioners' suspicions. In fact, Bacon believed the new science would progress more rapidly if it took a leaf directly from the inquisitors' book:

> ...a useful light may be gained, not only for a true judgment of the offenses of persons charged with such practices [witchcraft], but likewise for the further disclosing of the secrets of nature. Neither ought a man to make scruple of entering and penetrating into these holes and corners, when the inquisition of truth is his whole object --as your majesty has shown in your own example.(34)

Bacon encouraged the scientist to "interrogate" nature, to penetrate her, and bend her to his will. The complex sexual politic of Bacon's epistemology is analyzed by Evelyn Fox Keller in Reflections on Gender and Science. (35) Keller deconstructs the significance of sexual metaphors in the articulation of three epistemological stances: (A) Plato's homoerotic view of knowledge which conceives of knowledge as a product of a spiritual union between a male mentor and male disciple; (B) Bacon's concept of knowledge as power which equates women and nature, and seeks domination over both; and (C) the Paracelsian alchemists' construction of knowledge which uses the metaphor of heterosexual intercourse to suggest that the unity of two different but, in a sense, equal parts is required to produce knowledge.

Bacon accepted the Platonic dualism which separated mind and body, cognitive and carnal pleasures. However Bacon embellished the Platonic view: in Bacon's texts, mind became synonymous with man and body/nature/matter assumed female persona. In place of the Platonic ideal of spiritual eroticism which rejected aggression and embraced love as the path to wisdom, the Baconian model sought mastery over nature. Bacon's sexual metaphors are graphic but ambiguous. Thus, for example, he urges the scientist to be a "chaste" bridegroom to nature and enter into "holy and legal wedlock" with her; but he also frequently refers to nature as a "common harlot" who must be taken against her will. (36) Bacon advises the scientist to overpower nature's resistance: to take her forceably and "bind her to your service and make her your slave". He maintains that the achievements of science will not "merely exert a gentle guidance over nature's course; they have the power to conquer and subdue her, to shake her to her foundations". (37)

B. Reproductive Images.

The ambiguities and dialectical tensions in Bacon's imagery are not simply perverse, they are also highly productive. Not only do they provide word-pictures that facilitate "continuous adaptation of our language to our continually expanding world"; they also provide the medium which permits male science to effect a semiotic theft of the womb. Bacon makes it clear that the marriage between science and nature is no ordinary union. He

ascribes unprecedented generative powers to it: "from this association you will secure an increase beyond all the hopes and prayers of ordinary marriages, to wit, a blessed race of Heroes and Superman". (38) In The Masculine Birth of Time, Bacon maintains that the new science will make "masculine birth" possible: it will generate virile minds receptive to and empowered by God's divine truth. In short, Bacon both denies and appropriates the power of the feminine principle. Keller contends that this twist of Bacon's pen covertly acknowledges the dialectical, even hermaphroditic, character of the scientific project. (39)

The ascent of mechanistic models changed the character of the project because it changed the world. Rene Descartes and Robert Boyle re-conceived nature as a lifeless object, as matter, cosmos, mechanism. Nature not only lost her gender, she lost her life, re: Merchant's The Death of Nature. (40) This radically altered the scientist's approach. Susan Bordo maintains that the death of nature required "re-birthing and re-imagining of knowledge"; she contends that Cartesian rationalism provided the seminal ideas for articulation of the new cosmology by recreating knowledge and the mechanical world as "masculine". (41) Cartesian dualism fostered an approach to inquiry which emphasized separation and difference, and established firm boundaries between man and nature (the "other" who in the fading mythology of the polar terms of the gender totemic still included woman); it also separated reason and emotion, and valorized detached, dispassionate, calculating, and abstract modes of cognition. In short, it objectified nature and her/its non-rational creatures. As a result, James Hillman maintains, "The specific consciousness we call scientific, Western and modern is the long sharpened tool of the masculine mind that has discarded parts of its own substance, calling it 'Eve', 'female', and and inferior". (42)

Although Eve was once more expelled from the garden, the obstetrical project of science continued. Boyle referred to nature as "God's great pregnant Automaton". (43) Boyle's metaphor seems to cast the scientist in the role of midwife. However, as the scientific outlook became more fully articulated, man not God became the procreative force; the modern scientist not only conceives, nurtures, and delivers seminal ideas, he also produces them.

The metaphors of twentieth century science continue to cultivate unnatural conceptions of conception. In Fathering the Unthinkable, Brian Easlea deconstructs the language and design aesthetics of nuclear scientists and displays the necrological inversion that the mythos of the pregnant phallus assumes in their work. (44) In the scatological horseplay of the discourse of atomic scientists, bombs were conceived as erect penises ready to explode. They were given names such as Little Boy, The Fat Man, George and Mike. Little Boy and The Fat Man, the bombs dropped on Hiroshima and Nagasaki, were decorated with graffiti of the "Up-the-Emperor's" variety.

Security restrictions literally made the work of atomic scientists the work of a secret society. Scientists working on The Manhattan Project were physically removed from the mainstream of American society; they were even forbidden to discuss their

work with their wives. Easlea's analysis of the language, work habits, value-orientations and politics of nuclear scientists leads him to conclude that,

> In the ideal Cartesian universe that is the ultimate refuge of the masculine man of science, there will exist no longer the feminine distraction of women, home and children, the constant reminder of masculine insufficiency, and nor will there exist sexual women to tempt and threaten --the universe will consist of male mind in increasing control of the matter of the universe, mind threatened with destruction only as a result of its own miscalculations in its on-going experimentation with itself and silent, passive, unquestioning matter. (45)

Carol Cohn, a self-proclaimed "feminist spy" in the Cartesian world of contemporary U.S. defense intellectuals, reports little change in the imagery of technostrategic discourse since the delivery of Little Boy and the Fat Man. (46) Sexual imagery is very much on display in the pursuit of "penetration aids" for missiles and bombs that will deliver our "megatonnage in one orgasmic whump"; insiders are permitted to "pat the missile" (a new B-1 bomber); the language even contains romantic and domestic metaphors as enemies "exchange" warheads, one missile "takes out" another, and weapon systems "marry up". (47) Cohn's deconstruction of the images in which defense intellectuals dress their version of the Cartesian enterprise supports the conclusion that "their project fails according to its own criteria":

> Much of their claim to legitimacy...is a claim to objectivity born of technical expertise and to the disciplined purging of the emotional valences that might threaten their objectivity. But if the surface of their discourse --its abstraction and technical jargon-- appears at first to support these claims, a look just below the surface does not. There we find currents of homoerotic excitement, heterosexual domination, the drive toward competency and mastery, the pleasures of membership in an elite and privileged group, the ultimate importance and meaning of membership in the priesthood, and the thrilling power of becoming Death, shatterer of worlds. How is it possible to hold this up as a paragon of cool-headed objectivity? (48)

It is possible because "cool-headed objectivity" is not as cool as pre-constructivist and pre-feminist epistemologies claimed. Cool-headed Cartesian rationality claims to be <u>disembodied</u> (pure, detached, dispassionate), but it is only <u>disconnected</u> from consciousness of its own troubled history, the "subterranean potency" of its metaphors, and its structural dependence on the invisible labors of women. (49) In short, it is possible because the phallus is in the paradigm.

III. Making Minds: Sexual and Reproductive Metaphors in the Discourse of Artificial Intelligence Scientists.

The Cartesian flight from embodiment/materialism reaches a climax in the research program of the artificial intelligence movement. Artificial intelligence (AI) is still a promise, a futuristic vision. It is a science fiction: an exercise of scientific imagination rather than a coding of empirical reality. But regardless of whether it is preface or blueprint, AI packs a powerful punch as ideology. Futurists claim AI will provide the software for transforming the world into an Information Society. AI is already invoked as warrant for restructuring industry in ways that replace human labor with robots that are unable to demand shares of the surplus value they produce. AI also provides the flash in the sales pitch of U.S. defense lobbyists who claim it will supply the brains for the "smart weapons" required by the Strategic Defense Initiative (Star Wars).

This section examines the mythmaking of AI scientists: what AI researchers say they are doing. The role androcentric modes of thinking play in the actual construction of AI models is explored elsewhere. (51) AI discourse should be of especial interest to constructivists because, unlike the discourses of Bacon, Boyle, Descartes, Einstein and Oppenheimer, it represents an on-going process. It should be of especial interest to feminists because AI talk can be interrupted, and perhaps redirected. It can be subjected to what Umberto Eco has called "semiological guerrilla warfare". (52)

Like Descartes and Boyle, AI researchers embrace mechanical metaphors. They conceive of mind as machine. Within their texts, the program is a metonymic surrogate for intelligence. AI researchers construct computer models of operations of mind by reducing its cognitive and biological processes to machine recognizable inputs. According to AI scientists, all interesting manifestations of human intelligence can be contained within programs. (53) Some of them even believe it is possible to precisely quantify and program the "odd little chemical-electrical cloud of activity that is our personality". (54)

Reproductive metaphors play a far more prominent role in AI discourse that copulative images although the later are invoked in predictable ways to represent inputs, circuitry, and connections. Birth, not sex, puts the poetry in this paradigm. Computers provide the central image. They are "omnipotent"; they are "god". (55) They are also incubators, (male) wombs, which are conceived as sites for generating new forms of life. This conception is expressed through three interconnected sets of birth images: images representing creativity, immortality, and progress.

A. Images of Creativity.

Some of the mythologizing of AI is conscious, intentional, and programmatic. In God and Golem, Inc. (1964), Norbert Wiener, the father of cybernetics maintained that machines that learn,

reproduce themselves, and coexist with man pose profound theological questions. (56) Wiener points out that if a contemporary of Bacon had claimed to be able to make machines which could "learn to play games or that should propagate themselves", he would surely have been burned by the Inquisition "unless he could convince some great patron that he could transmute the base metals into gold, as Rabbi Low of Prague, who claimed that his incantations blew breath of life into the Golem of clay, had persuaded the Emperor Rudolf". (57) According to the folklore of AI scientists, Weiner, John von Neuman, Gerald Sussman, Marvin Minsky, and Joel Moses all claimed to be actual descendents of Rabbi Low, perhaps the first mortal man to be credited with creating life without using woman as a vessel. (58) Moreover, Low's descendents believe they are carrying on the family tradition. They maintain that they have already given birth to four generations of Golem. The labor pains they are currently experiencing in their attempt to give birth to "the fifth generation" of computers are extraordinary because the pregnant phallus is more pregnant than usual; it is about to bring forth very special progeny --a superchild who will be able to reproduce itself without the agency of either man or woman. (59)

B. Images of Immortality.

According to the fathers-to-be, this superchild may also be the one who cuts through the genetic coding of the universe and produces "the next step in human evolution". (60) Some AI scientists believe this child will transform its fathers into "supermen". (61) They claim it will permit them to "download" the contends of their own minds into programs and thereby achieve immortality.

In a forthcoming book entitled Mind Children, one proud papa, Hans Moravec of Carnegie Mellon, claims:

> The things we are building are our children, the next generations. They're carrying on all our abilities, only they're doing it better' (Moravec 1987:16). (62)

The gender of these children is never in doubt; when references to AI or robotics are personified, male pronouns are used. Marvin Sussman maintains that these mind children have brought men to the threshold of immortality: "the machine can last forever. Even if it doesn't last forever, you can always dump it out onto tape and make backups..." (63)

The Cartesian disconnection of AI researchers which permits them to conflate mind and machine also permits them to conceive of biological death as a minor episode in the life-cycle of a superman: "If you make a machine that contains the contends of your mind, then that machine is you". (64) Within the mythos of AI modelers, biological man becomes an obstacle to be conquered and rationalized. The contents of mind cannot be downloaded into immortality until the information channels are cleaned up. For this reason, AI modeling requires modelers to subject cognitive processes to the Law of the Hammer. That is, the AI modeler must reduce complex cognitive and

biological processes to a series of univocal binary commands. Modeling even a very simple movement like raising the arm of a man to press a lever may require identifying, mapping, and simulating hundreds perhaps even thousands of cognitive and neurological messages. Add to this, the fact that within biological man these messages are often confounded by the 'noise' of indecision, procrastination, memory, reflection, love, lust, and other sentiments, values and intentions that appear to be irrelevant to the immediate task at hand. Cleaning up the information channels to create a model which will program a robot to push a level with the same efficiency whether the lever releases bombs or coffee cups is a genuine achievement of Cartesian logic. Faulting the AI modeler for preferring clean channels to cluttered ones is like faulting the plumber for preferring clean drains to clogged ones. Both find their efforts blocked by the waste products of biological man.

The AI modeler's dream of a clean machine is a dream of Cartesian transcendence, perhaps even Redemption. But where Descartes wanted to control the noise of embodiment, AI researchers want to eliminate the body. Rodney Brooks explains why he wants to eliminate "the wet stuff" --human bodies-- from the equation: "We are sort of locked into our genetic structure. At the moment we might be able to tweek our genetic structure a little bit, but nothing severe". (65) Brooks sees "an advantage to building robots out of silicon and stuff like that, because we know how to control that fabrication process pretty well" whereas we have "trouble with" biology: "We can't add more brain cells to us, but we can add more processors, more silicon, to a robot". (66) In sum, robots are easier to expand, repair, and control than their prototypes.

Because the legend of the pregnant phallus requires the scientist to make love to himself, it encourages Narcissism. Sherry Turkle reports the following conversation between AI scientists. Don Norman says, "I have a dream to create my own robot. To give it my intelligence. To make it mine, my mind, to see myself in it. Ever since I was a kid". Roger Schank responds, "So who doesn't? I have always wanted to make a mind. Create something like that. It is the most exciting thing you could do. The most important thing anyone could do". Another scientist, Gary Drescher tells Turkle, "We have the right to create life, but not the right to take our act lightly". Drescher believes scientists have ethical obligations in a society where human and artificial intelligence live together. Like Isaac Asimov, Drescher entertains the idea that AI may make a new form of murder possible:

> People always talk about pulling the plug on computers as though when it comes to that they will be saving the world, performing the ultimate moral act. But that is science fiction. In real life, it will probably be the other way around. We are going to be creating consciousness, creating lives, and then people may simply want to pull the plug when one of these intelligences doesn't agree with them. (67)

C. Images of Progress.

Some AI scientists acknowledge that the next step in evolution may render humans obsolete. Marvin Minsky thinks "people will get feed up with bodies after a while". (68) He predicts that like the dinosaurs we might disappear leaving behind a "society" of interacting and self-generating computer systems. (69)

Evolutionary analogies are common in AI discourse. They appear to represent a form of masculine display: a way of saying my science is bigger (more potent/pregnant) than yours. However, they are also used to convey distain for and distance from conventional conceptions of life, death, thought, and morality. That is, they signal a radical departure from all previous ways of knowing and being in the world. Thus, Moravec asserts, "I have no loyalty to DNA", and Mike Blackwell claims, "Bodies have served their purpose". (70) Moravec valorizes the departure, the irrevocable break with the past: "We are on a threshold of a change in the universe comparable to the transition from non-life to life". (71) On one level, AI scientists seem to be embracing a return to pre-Baconian animism in which matter cum machine is endowed with life and anthropomorphosized. However, there is more to the equation. The transition is not "to life". There is a change in signs which negates the value of human life: machines evolve, humans download or die. Within AI's mechanistic reconstruction of evolutionary theory, the pregnant phallus finally achieves its telos: mind is released from body and man is released from his biological dependence on woman. Moravec describes the brave new world of AI:

> All our culture can be taken over by robots. It'll be boring to be human...We can't beat the computers. So it opens another possibility. We can survive by moving over into their forms. ...because we exist in a competitive economy, because each increment in technology provides an advantage for the possessor...Even if you can keep them (the machines) slaves for a long time, more and more decision-making will be passed over to them because of the competitiveness.
>
> We may still be left around, like the birds. It may be that we can arrange things so the machines leave us alone. But sooner or later they'll accidentally step on us. They'll need the material of the earth". (72)

D. Reproduction as Destruction in AI Discourse.

In the transition from life to program, the clean machine replaces its sweaty, plodding, loving, lusting, and aging progenitor. And, the pregnant phallus eliminates the "wet stuff" that permitted its prototype to penetrate Baconian "holes and corners". The violence of the vision is neatly occluded by comic strip captions. Robots will accidentally step on "us", but that's okay because "we" won't really be there anyhow: "our" now immortal minds will be able to abandon mother earth entirely. Indeed, some

AI scientists believe it is imperative that "we" get some minds off of this nuclear and ecologically endangered planet and into space colonies before it is too late. (73)

Inevitably the question is raised, Which minds? Since the capacity of the most powerful parallel processing machines (connection machines) will be finite, not everyone will be able to get out of their bodies or off of the planet. Some of "us" will be stepped on, incinerated or gassed. So, who gets downloaded into the programs? Evolutionary logic dictates the answer. The best minds, of course, the kinds of minds that are readily available for modeling in the AI laboratories at MIT, Stanford, and Carnegie-Mellon: minds of upper middle-class, white, American males. The same minds that conceive of a future in which AI will render participatory democracy obsolete; machines, not people, will control the world's nuclear arsenals; new forms of slavery will be introduced in which living machines (cyborgs) programmed to be "ethical" will serve as slaves; and robots will be programmed to meet all (in and out of body) erotic needs and thereby render human intercourse and reproduction redundant. (74)

The social fingerprints revealed by deconstruction of the mythos and metaphors of AI discourse display a familiar design. AI discourse is a discourse of control; it builds hierarchy into the hard-wiring of its circuitry. Like the fantasies that accompanied the conception of Little Boy and The Fat Man, the robotic fantasies of AI researchers presuppose the necessity of "the violent mastery and destruction of others". (75) Comic book talk papers over the perversity of AI concepts of creativity, immortality, and progress, but MIT researcher and outspoken in-house critic of AI ideology/eschatology, Joseph Weizenbaum, cuts through the cartoon images and conceives the perversity within the same frame history has used to comprehend its previous incarnations: genocide. (76)

The faded mythology encoded in AI discourse demonstrates that it is not univocal discourse; like the technostrategic discourse analyzed by Cohn, it fails according to its own criteria. It is as far from a "paragon of cool-headed rationality" as Bacon's belief in the diabolical powers of witches. However, if we accept the constructivist contentions that (a) unexamined myths have subterranean potency and (b) scientific metaphors change the world; we should not dismiss the perverse reproductive metaphors of AI talk and texts as only primitive regressions or science fictions. AI scientists may be big children who have not given up their "sandbox fantasies" or sublimated their dreams of omnipotence; however, they are also members of a powerful scientific elite: researchers, teachers, and gateskeepers of the most advanced and prestigious academic computer research centers in the world. (77) The metaphors they use to conceive nature are far more potent than yours of mine; indeed, Donna Haraway contends biology has already undergone a cybernetic revolution in which natural objects have been retheorized as "technological devices properly understood in terms of mechanisms of production and storage of information". (78)

Unlike Bacon's patriarchal metaphors which saw knowledge issuing from a chaste marriage between men's mind and nature,

cybernetic metaphors locate the genesis of knowledge in the marriage and (male) machines. The mythos of male-bonding encoded in AI discourse bears no resemblance to Plato's homoerotic vision. To the contrary, AI metaphors replace Eros with objects, fetishes made of circuits and chips. Where Baconian epistemology suppressed the female principle, AI discourse negates the human principle, and as Weizenbaum points out, "There's nothing left after you've destroyed the human species". (79)

IV. Coitus Interruptus: Feminist Alternatives.

Constructivism takes away our innocence. We can no longer pretend that science is free of social fingerprints, that language is free of birthmarks, or that we can copulate without bodies, conceive without wombs or live without brain cells. Constructivism not only acknowledges the limits of existing bodies of knowledge, it recognizes the limits of our capacity to know, to construct meaning. In short, it reminds us that we are mortals not heroes or supermen.

Feminist versions of the constructivist project go even further. They remind us that some mortals are female, and that our embodiments of word and world, our metaphors and experiences, have not been given voice within the discourses of Western science. For this reason, they challenge science's claims to universality and epistemological privilege: its claim to "a-perspectivity". (80)

Deconstructions of the myths and metaphors that preserve the "subterranean potency" of androcentric conceptions within scientific discourse demonstrate that scientific talk and texts, like all talk and texts, involve complex social, linguistic, rhetorical, and dialectical processes. Contra the post-Baconian dream of linguistic purity, these deconstructions show that language is a double-agent. It communicates by confounding univocal and equivocal messages; it contains ambiguities, double inscriptions, hieroglyphs, knots, paleosymbolism, irony, tropes, and other social and textual fingerprints; and, these fingerprints are indelible. Consequently, scientific discourse does not meet the norms of traditional models of scientific rationality. It fails according to its own criteria because it is far richer, far more pregnant with possibility, than positivists, empiricists, realists, and instrumentalists conceived.

The richness of scientific discourse, its embodiment and intertextuality, also pose problems for feminist epistemologies. The deep embeddedness of the totemic of gender within Western languages, the continued potency/utility of the pregnant phallus as a metaphoric instrument of scientific and administrative power, and the lack of grounds for convergence among the alternative constructions of reality available through recovery of "submerged knowledges" of modern cultures seem to suggest that the penis is in the paradigm and there is little we can do now except record its erections and cherish the seminal ideas they produce. (81) The intractability of the masculinist bias of science has led some feminists to conclude that the canons of scientific objectivity are implicit propaganda for patriarchy; that "scientific rationality is directly implicated in the maintenance of mascu-

linity in our kind of culture". (82) Thus, for example, Harding and Jane Flax abandon the effort to reform science and embrace instead a convergence of feminist and postmodernist epistemologies which share "a profound skepticism regarding universal (or universalizing) claims about the existence, nature and powers of reason, progress, science, language and the 'subject/self'". Feminist postmodernism claims that modern life "fractures" identities, and that postmodernism provides more plausible epistemologies and forms of resistance because it is grounded in awareness of the fracturing processes. (84) In short, this view maintains that modern science has exhausted its emancipatory potential.

Other feminist critics of appear to be more hopeful; they seem to believe that either (a) the fractures can be mended, or (b) a more nurturing feminist epistemological principle will supplant the destructive thrust of masculinist epistemology. Bordo predicts a return of the repressed parts of mind pointing out that the "historical identification of rationality and intelligence with masculine modes of detachment, distance, and clarity has disclosed its limitations, and it is necessary (and inevitable) that feminine modes should appear as revealing more innovative, more humane, and more hopeful perspectives". (85) Bordo's conviction that recovery of the female principle can resolve current epistemological sterility is shared by the new French feminisms: their aesthetic seeks to valorize metaphors of maternity, interiority, and nurturance. (86)

Feminist moves to take back the womb are necessary steps in the current semiological guerrilla warfare. They right a historical wrong, and advance the critique. However, in my judgment, they cannot heal the fractured mind or provide a viable alternative to what Rose calls "exterminatory science" for the following reasons. (87 First, masculinity and femininity are not simply complementary poles of thought, not two symmetrical halves of the fruit of the tree of knowledge. They are assymetrical categories based upon domination and submission. (88) Both are partial, distorted, and damaged renderings of the range of male and female potential. Putting master and slave in the same bed does not eliminate slavery. It cannot produce healthy minds. Second, reversing the terms of the Baconian equation will not work either. A virile womb is not much better than a pregnant phallus (although it is slightly more anatomically correct since females can contain potentially virile male offspring in their wombs). Similarly, women writing in Cixous' "white ink"/mother's milk may tell different stories but they will come no closer to telling the whole story of embodiment and mortality than do the seminal ideas produced by men. (89) Third, feminist critiques which valorize difference inadvertently buy into post-Baconian masculinist constructions of sex, gender, and knowledge. They conceive of sensuality narrowly and instrumentally as the <u>work</u> of genitals and reproductive organs which <u>produce</u> eggs, milk, seed, and future workers; they implicitly embrace the Christian/capitalist denial of the pleasure principle. (90) They may even reproduce the homophobic bias of the sex/gender systems of contemporary Western societies. (91) This narrowing of vision restricts articulations of embodiment to a very limited range of human experience. It precludes full recovery and reconstruction of Eros (or heart), as auspicies for carnal and

cognitive knowledge. (92) Fourth, exposing inadequacies of masculinist science is a necessary step in the feminist critique, but it does not fully embrace the dialectic of history. The scientific revolutions of the seventeenth and eighteenth centuries were complex and powerful social movements which changed the world. Modern science was both a project of domination and emancipation. Baconian science was an egalitarian project that helped break the hereditary rule of feudal societies; its epistemology not only rationalized domination of nature, fueled industry, and split the atom; it also improved crops, battled disease, extended life, and ultimately freed Western woman from the annual occupations of her womb that had kept her bound to home and hearth and frequently sentenced her to an early death. Not the Progress envisioned by positivism, but nevertheless modern science has made some of the daily labors of ordinary women and men a little less oppressive.

There is another path to feminist resistance, one that combines feminist theory and scientific practice. Some feminists are stretching the metaphors and models of science to accommodate adaptation to "our continually expanding world": a world that is being changed by feminism. They are empiricists whose attempts to correct the errors of traditional empiricism have undercovered the internal inconsistences in the founding assumptions of empiricism; as a result, Harding points out, this group of academic scientists has "a radical future". (93) They are still doing science, but like Bacon they are trying to create a New Science. Thus, for example, Ruth Hubbard tells a new story of embodiment. Hubbard re-conceives of the female egg as an active partner in the process of fertilization rather than as a passive princess waiting patiently for the sperm prince to awaken her from her slumbers. She looks at what happens to scientific questions when the gender totemic is treated as a null hypothesis: what happens when we look at the similarities instead of the differences in males and females of the same species. (94) Sandra Blaffer Hrdy examines the mating behaviors of monkeys and discovers that females are not nearly as discrete, selective or as unappreciative of the pleasures of the flesh as male scientists claimed. (95) Keller and Grontkowski speculate on what physics would sound or feel like if it had been constructed on aural or tactile instead of the spatial metaphors favored by males. (96) The process of interrupting and correcting the talk and texts of male science has just begun, but for feminists like Haraway, it is a way of practicing "politics by other means". (97)

Yes, and poetry too! For the first step in scientific revolutions (as in political revolutions) is to change the names; because, as Hesse has pointed out, scientific revolutions are metaphoric redescriptions of nature, not codings of revolutionary new insights into the intrinsic nature of phenomena. (98) To date, feminist redescriptions of self, science, sexuality, nature, and the world have largely operated at the margins of science. Except for primatology, the scientific establishment has generally ignored them.

It is not yet clear whether the power of the new feminist perspectives, like the power of the genie, comes from being in the bottle: whether their innovations can function only as critiques

of male science or whether they can articulate new ways of knowing. Because the language of formal reasoning is the language of the public sphere, until recently the exclusive theater of male performances, it does not readily lend itself to feminist reform. The mythos buried within its metaphors are androcentric and misogynist. Moreover, since metaphors are the anchors of abstract thought, they cannot be eliminated from scientific discourse. To expand the range of scientific discourse, we must therefore expand its metaphoric sweep.

Preliminary attempts to deconstruct the submerged knowledge of (literate, Western, white) women have recovered some recurrent metaphors but as yet no coherent mythos describing being and knowing: the yield includes images of circles, webs, and networks, iconic images which also assume circular forms (e.g. Judy Chicago's dinner-plate/vagina), and within American literary texts, contextuality, piecing, patching, and quilting are recurrent gender-specific images. (99) Such recoveries are suggestive but they do not take us very far down the road to universalism or provide us with a conceptual platform broad enough to support articulation of a new science. Beyond suggesting remedial models and taxonomies which are less hierarchical, more permeable, and perhaps more reflexive than the male prototypes, it is not yet clear how metaphors drawn from the spheres of women's experience can inform scientific thought. Images of domesticity and necessity keep our feet on the ground; but, the achievements of Western science as well as its perversions have been possible because they have taken flight on the wings of transcendent metaphors. The destructive thrusts of such flights need to be contained and domesticated. Survival of the planet seems to require termination of phallic pregnancies, but it is unclear how the "culture of death" can be restrained or negated by grafting feminist insights onto masculinist oversights or by substituting one partial and damaged vision for another. The ultimate achievement of the new epistemologies may be to identify the limits of language and knowledge. Or, perhaps more hopefully, feminist practice may generate new ways of being in the world, of caring for it and each other, and thereby give birth to new ways of knowing and describing the world.

If feminist attempts to rename nature and regenerate scientific models begin to achieve resonance outside of feminism, we can probably anticipate strong resistance from powerful factions within mainstream science because the radical feminist movement in science seeks to: (a) destroy the foundations of masculinist science, and (b) transform science and the world.

Without feminist interruptions, however, scientific talk and texts will continue to support metaphoric subtexts which valorize "the thrilling power of becoming Death, shatterer of worlds". Scientists will continue to normalize talk about <u>downloading</u> the best (male) minds into immortality before mortals annihilate themselves and their planet. The challenges facing those who would womanize or "Paracelize" science are enormous, but constructivist demystifications of previous scientific revolutions reduce these challenges to human scale. They encourage us to think of them as challenges to human intelligence which can be met by inventive mortals without the interventions of gods, supermen or cyborgs.

Notes.

1. Richard A. Cherwitz and James W. Hikins, Communication and Knowledge: An Investigation in Rhetorical Epistemology (Columbus: University of South Carolina Press, 1986). The constructivist position has been extensively criticized; Cherwitz and Hikins are among a growing chorus of advocates of the "return to realism" position. Their argument is, however, more prescriptive than it is persuasive; they do not effectively redress the challenges constructivism poses with regard to the universality of the truth claims of Western science or the adequacy of its canons of validation and verification. They virtually ignore the challenges posed by feminist constructivism. Ruth Bleier points out that those working within the sociology of scientific knowledge, with few exceptions, have also remained "peculiarly oblivious" to feminist scholarship which is making fundamental contributions to the constructivist project. See "Introduction" to Feminist Approaches to Science (New York: Pergamon Press, 1986), p. 5. The first two sections of this paper attempt to situate work in feminist epistemology within the context of the constructivism; the concluding section examines the limitations of the feminist version of the constructivist project.

2. Michael Polanyi, Personal Knowledge (Chicago: University of Chicago Press, 1958); Thomas S. Kuhn, The Structure of Scientific Revolutions (Chicago: University of Chicago Press, 1970); David Bloor, Knowledge and Social Imagery (London: Routledge and Kegan Paul, 1977); and Barry Barnes, Interests and the Growth of Knowledge (Boston: Routledge and Kegan Paul, 1977).

3. Bloor (n. 2 above); Bruno LaTour and Steve Woolgar, Laboratory Life: The Social Construction of Scientific Facts (Beverly Hills: Sage, 1979); Augustine Brannigan, The Social Basis of Scientific Discoveries (London: Cambridge University Press, 1981); John O'Neill, "The Literary Production of Natural and Social Science Inquiry: Issues and Applications in the Social Organization of Science", Canadian Journal of Sociology 6 (1981): 105-120, and O'Neill's "An Realist Model of Knowledge: With a Phenomenological Deconstruction of its Model of Man", Philosophy of the Social Sciences 16 (1986): 1-19; James Clifford and George E. Marcus, editors, Writing Culture: The Poetics and Politics of Ethnography (Berkeley: University of California Press, 1986); and Sandra Harding, The Science Question in Feminism (Ithaca: Cornell University Press, 1986).

4. Bloor (n. 2 above), p. 73.

5. For an example of this kind of criticism targeting feminist constructivism, see Margarita Levin, "Caring New World: Feminism and Science", The American Scholar (Winter 1988): 100-106.

6. Bloor (n. 2 above),

7. Evelyn Fox Keller, "Gender and Science" in Discovering Reality edited by Sandra Harding and Merrill B. Hintikka (Dordrecht: D. Reidel Publishing, 1983), p. 186.

8. Harding (n. 3 above); Keller (n. 7 above), p. 186; Bloor (n. 2 above), p. 70; see also Jean-Francois Lyotard, The Postmodern Condition: A Report on Knowledge (University of Minnesota Press, 1984).

9. Bloor (n. 2 above) explores the processes of ideological

transfer which permit metaphors to carry the values and assumptions of ordinary language into scientific discourse.

In addition to deconstruction of the language of science, constructivist studies also (a) attempt to identify gaps in substantive scientific knowledge created by socially structured silences; (b) display the ways science and scientific technologies function as power-knowledge; (c) investigate conditions and socialization processes which encourage scientific creativity; and (d) explore strategies for building reflexivity into scientific explanations.

10. Langer quoted by Sue Curry Jansen in Censorship: The Knot that Binds Power and Knowledge (Oxford University Press, 1988), p. 7.

11. Evelyn Fox Keller, Reflections on Gender and Science (New Haven: Yale University Press, 1985).

12. Brian Vickers, Editor. English Science, Bacon and Newton (Cambridge: Cambridge University Press, 1987).

13. Nietzsche quoted by Richard Rorty in "The Contingency of Language", London Review of Books 17 (April 17, 1986): 6.

14. Mary Hesse, Models and Analogies in Science (South Bend: University of Notre Dame Press, 1966, and Hesse's Revolutions and Reconstructions in the Philosophy of Science (Bloomington: Indiana University Press, 1980; Jacques Derrida, "White Mythology: Metaphor in the Text of Philosophy", New Literary History 6, 1 (Autumn 1974): 5-74; Bloor (n. 2 above); Richard Rorty (n. 13 above) and Philosophy and the Mirror of Nature (Princeton: Princeton University Press, 1979); George Lakoff, Women, Fire, and Dangerous Things: What Categories Reveal About the Mind (Chicago: University of Chicago Press, 1987), and Lakoff and Mark Johnson, Metaphors We Live By (Chicago: University of Chicago Press, 1980).

15. Lakoff (n. 14 above), p. xiv.

16. Hesse 1966 (n. 14 above), p. 177.

17. Lakoff and Johnson (n. 14 above).

18. Lakoff (n. 14 above), p. xiv,

19. Hesse 1966 (n. 14 above), p. 162.

20. Carolyn Merchant, The Death of Nature: Women, Ecology and The Scientific Revolution (New York: Harper and Row, 1980).

21. Hesse 1966 (n. 14 above), p. 163.

22. Simone de Beauvoir, The Second Sex (New York: Vintage Books, 1974); Arthur Koestler, The Act of Creation (New York: The Macmillan Company, 1967); Keller (n. 11 above); Carol Cohn, "Sex and Death in the Rational World of Defense Intellectuals", Signs 12,4 (1987): 687-718); Susan Stanford Friedman, "Creativity and The Childbirth Metaphor", Feminist Studies 13,1 (Spring 1987): 49-78.

23. Harding (n. 3 above), p. 104.

24. George Steiner, After Babel: Aspects of Language and Translation (New York: Oxford University Press, 1975).

25. Rorty (n. 13 above), p. 6.

26. Lakoff and Johnson (n. 14 above).

27. Women have, of course, journeyed, build, discovered, etc. However their achievements are not recognized by society or valorized within the mythos of Western metaphors; indeed, they are frequently erased. See for example Friedman (n. 22 above). Women have also pursued knowledge, reasoned, created, and argued, and many have

effectively pursued these activities using the metaphoric conventions outlined above; nevertheless the dominant language and canons of logic have been stacked against public recognition of the woman of knowledge. See Carol Gilligan, In A Different Voice (Cambridge: Harvard University Press, 1982); and Women's Ways of Knowing edited by Mary Field Belenky, Blythe McVicker Clinchy, Nancy Rule Goldberger, and Jill Mattuck Tarule (New York: Basic Books, 1986).

28. Lionel Tiger, Men in Groups (New York: Random House, 1969).

29. Brian Easlea, Fathering the Unthinkable (London: Pluto, 1983), p. 17.

30. Moshowitz, Abbe. Conquest of Will: Information Processing in Human Affairs (New York: Addison and Wesley, 1976).

31. Merchant (n. 20 above); Keller (n. 11 above).

32. Easlea (n. 29 above), p. 19.

33. Merchant (n. 20 above), p. 165.

34. Bacon quoted by Merchant (n. 20 above), p. 168. Emphasis added by Merchant.

35. Keller (n. 11 above).

36. Ibid., Bacon quoted by Keller, p. 36; Bacon quoted by Merchant (n. 20 above), p. 171.

37. Bacon quoted by Keller (n. 11 above), p. 40.

38. Ibid., p. 36.

39. Keller (n. 11 above).

40. Merchant (n. 20 above).

41. Susan Bordo, "The Cartesian Masculinization of Thought", Signs 11,3 (1986), p. 441.

42. James Hillman, The Myth of Analysis (New York: Harper and Row, 1972), p. 250; also quoted by Bordo (n. 41), p. 441.

43. Boyle quoted by Bordo (n. 41 above), p. 453.

44. Easlea (n. 29 above).

45. Easlea (n. 29 above), p. 175.

46. Cohn (n. 22 above).

47. Ibid,, pp. 693, 695, 698.

48. Ibid., p. 717.

49. Hilary Rose, "Hand, Brain and Heart: A Feminist Epistemology for the Natural Sciences", Signs 9,1 (1983): 73-90.

50. Sue Curry Jansen, "Science, Gender, and a Feminist Sociology of Science: The Case of Artificial Intelligence". Paper presented at meetings of American Sociological Association, Chicago 1987.

My analysis of AI discourse does not, of course, apply to the language and mythos animating Japanese AI research.

51. Umberto Eco, Travels in Hyper-Reality (New York: Harcourt Brace Jovanovich, 1986), p. 135.

52. Marvin Minsky, Society of Mind (New York: Simon and Schuster, 1987).

53. Grant Fjermedal, The Tomorrow Makers (New York: Macmillan, 1986), p. 7.

54. Roger C. Schank and Robert P. Abelson, Scripts, Plans, Goals and Understanding: An Inquiry into Human Knowledge Structures (Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1977), p. 20.

55. Norbert Wiener, God and Golem, Inc: A Comment on Certain Points where Cybernetics Impinges on Religion (Cambridge: The MIT Press, 1964).

56. Ibid., pp. 49-50.

57. Sherry Turkle, The Second Self: Computers and The Human Spirit (New York: Simon and Schuster, 1984).

Myths of male birth are of course deeply embedded in the creation stories of Western culture from Zeus birthing of Athene from his head to God's creation of Eve from Adam's rib.

58. Edward A, Feigenbaum and Pamela McCorduck, The Fifth Generation (New York: New American Library, 1984).

59. Fredkin quoted by Turkle (n. 57 above), p. 242.

60. Ibid., p. 262.

61. Moravec quoted by Michael Hirsch in "Computers Envisioned as Successors to Humans", The Buffalo News (June 14, 1987): 16.

62. Sussman quoted by Fjermedal (n. 53 above), p. 8.

63. Ibid.

64. Brooks quoted by Fjermedal (n. 53 above), p. 33.

65. Ibid.

66. Norman, Schank, and Drescher quoted by Turkle (n. 57 above), p. 262.

67. Minsky quoted by Fjermedal (n. 53 above), p. 8.

68. Minsky (n. 52 above).

69. Moravec quoted by Fjermedal (n. 53 above), p. 60.

70. Ibid., p. 8.

71. Moravec quote by Hirsch (n. 61 above).

72. Cohn (n. 22 above) points out that in the technostrategic discourse of defense intellectuals, unlike most discourse analyzed by deconstructionists, the 'reference point' is not white males but weapons. A similar occlusion occurs in some AI texts where the 'minds' programmed into the machines become the reference point for discussions of life, the future, even moral values. However the reference point frequently slips in ways that the blur distinction between the mind of the scientist and the mind he wants to make. This slippage permits first person statements that possess far greater hubris than ordinary discourse usually tolerates as 'I' artificially become program, computer, god.

73. Fjermedal (n. 53 above). This is only a small sample of the futuristic projects AI scientists shared with Fjermedal. In my judgment, the common currency of these projections is exceptional political and sociological naivete. For additional, reports of AI futurism, see Theodore Roszak's The Cult of Information: The Folklore of Computers and The True Art of Thinking (New York: Pantheon Books, 1986). Unlike Fjermedal who is an enthusiast of AI, Roszak's is highly critical of cybernetic power-knowledge.

74. Hilary Rose, "Beyond Masculinist Realities: A Feminist Epistemology for the Sciences" in Feminist Approaches to Science edited by Bleier (n. 1), p. 69.

75. Tiger (n. 28 above).

76. Joseph Weizenbaum, Computer Power and Human Reason (San Francisco: W.H. Freeman, 1976).

77. Weizenbaum discusses "sandbox fantasies" and omnipotent delusions of computer scientists in "Not Without Us", Zeta (January 1988): 94-96. Fjermedal (n. 53 above) reports most AI researchers were heavy-users of science fiction during adolescence. In their programmatic essays they sometimes cite science fiction writers, and science fiction writers are frequently found within the invisible colleges of author's acknowledgements. Thus, for

example, in his acknowledgement for The Society of Mind (n. 52 above), Minsky writes, "My development was also strongly influenced first by the writing and later by the friendship of Arthur C. Clake, Robert Heinlein, Frederick Pohl, and most of all Isaac Asimov" (p. 325). This would suggest that feminist deconstructions of male science fictions and constructions of feminist science fictions should be regarded as more than literary exercises. They may also be ways of doing politics and science by other means.

78. Donna Haraway, "The Biological Enterprise", Radical History Review (Spring-Summer 1979): 223. See also Turkle (n. 57 above) for discussion of the questions cybernetic metaphors raise about human identity and socialization.

For a different and ultimately less pessimistic view of the cybernetic revolution than the one develeoped in this paper see also Haraway's "A Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980's", Socialist Review 80,2 (Mar.-Apr. 1985): 65-107.

79. Weizenbaum quoted by Fjermedal (n. 53 above), p. 140.

80. The claim that the male view is the unbiased view --that the "neutral observer" is really neutral and neuter. See Catherine A. MacKinnon, "Feminism, Marxism, Method and the State: An Agenda for Theory", Signs 7,3 (Spring 1982): 515-544.

81. The concept of "submerged knowledges" was developed by Michel Foucault in A History of Sexuality, Vol. I: Introduction (New York: Random House, 1980), p. 49.

82. Harding (n. 3 above), p. 34n.

83. Ibid.; see also Jane Flax, "Postmodernism and Gender Relations in Feminist Theory", Signs 12,4 (1987): 621-642.

84. Harding (n. 3 above).

85. Bordo (n. 41 above), p. 456.

86. Helene Cixous, "The Laugh of the Medusa" in New French Feminists edited by Elaine Marks and Isabelle de Courtivron (New York: Schocken Books, 1981), pp. 245-264; Lucy Irigaray, "When Our Lips Speak Together", Signs 6,1 (Autumn 1980): 69-79; Julia Kristeva, Desire in Language (New York: Columbia University Press, 1980).

87. Rose (n. 49 above), p. 75.

88. See de Beauvoir (n. 21 above); Kathy E. Ferguson, The Feminist Case Against Bureaucracy (Philadelphia: Temple University Press, 1984); Harding (n. 3 above); R.W. Connell, Gender and Power (Stanford: Stanford University Press, 1987); and many others.

89. Cixous (n. 62 above); see also Domna C. Stanton, "Difference on Trial: A Critique of the Maternal Metaphor in Cixous, Irigaray, and Kristeva" in The Poetics of Gender edited by Nancy K. Miller (New York: Columbia University Press, 1986), pp. 157-182. Post-modernists contend there is no whole story, only a tendency for the powerful to impose their version of reality on others. Nevertheless gender identities are not our only identities; we are also members of social classes, ethnic and religious groups, occupations, and nations, etc. In short, the fractures of modernity are multiple.

90. Herbert Marcuse, Eros and Civilization (Boston: Beacon, 1955); Susan Griffin, Pornography and Silence: Culture's Revenge Against Nature (New York: Random House, 1981).

91. Gayle Rubin, "The Traffic in Women: Notes on the

'Political Economy' of Sex" in Toward an Anthropology of Women edited by Rayna Rapp Reiter (New York: Monthly Review Press, 1975.

92. Griffin seeks to recovery the erotic approach to knowing and being in the world (n. 86 above); see also Griffin's Woman and Nature: The Roaring Inside Her (New York: Harper and Row, 1978). Hilary Rose (n. 49 above) also asserts the importance of 'heart' in feminist epistemologies. Indeed 'caring' is a metaphoric thread that runs through much recent feminist epistemological thought; it was, of course, also an element in the Platonic and Paracelsian epistemologies examined by Merchant (n. 20 above) and Keller (n. 11 above).

93. Harding (n. 3 above), p. 162.

94. Ruth Hubbard, M.S. Henifin, and Barbara Fried, editors, Biological Women: The Convenient Myth (Cambridge: Schenkman, 1982).

95. Sarah Blaffer Hrdy, "Empathy, Polyandry, and the Myth of the Coy Female" in Bleier (n. 1 above), pp. 119-146.

96. Evelyn Fox Keller and Christine E. Grontkowski, "The Mind's Eye" in Harding and Hintikka (n. 7 above), pp. 207-224.

97. Donna Haraway, "Primatology is Politics by Other Means" in (Bleier, n. 1 above), pp. 77-118.

98. Hesse 1980 (n. 14 above).

99. See Mary Daly, Gyn/Ecology (Boston: Beacon 1978) and Pure Lust: Elementary Feminist Philosophy (Boston: Beacon Press, 1984) for self-conscious attempts to articulate "metaphors of metamorphosis". See also Dorothy Smith's discussion of circles in "A Peculiar Eclipsing: Women's Exclusion from Man's Culture", Women's Studies International Quarterly 1,4 (1978): 281-296; Gilligan's discussion of webs in (n. 27 above); Karen Sacks' "Networking: When Potluck is Political", MS 11 (April 1983): 97-96; and Elaine Showalter's discussion of quilting in The Poetics of Gender edited by Nancy K. Miller (New York: Columbia University Press, 1986).

Some feminists have sought recovery and articulation of a women-centered mythos through explorations of Godess worship. This may be a productive move for those interested in feminist theology; however, in my judgment, it can offer little to feminists trained in the critical canons of scientific inquiry who are abandoning traditional empiricism because it is not critical enough, re: it protects its own assumptions from criticism by treating them as 'sacred' (Bloor n. 2 above).